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Ravera et al.

[11] **3,900,256**

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[54] **ELECTROSTATIC COPYING MACHINE AND SYNCHRONIZING CONTROL SYSTEM THEREFOR**

[75] Inventors: **Giovanni Ravera; Giorgio Siletto,** both of Turin; **Carlo Bellis,** Strambino, all of Italy

[73] Assignee: **Ing. C. Olivette & C., S.p.A.,** Turin, Italy

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July 9, 1973 Italy 69035/73

[52] **U.S. Cl.** **355/14;** 355/8

[51] **Int. Cl.²** **G03G 15/00**

[58] **Field of Search** ..... 355/14, 13, 8, 3 R, 16

[56] **References Cited**

UNITED STATES PATENTS

3,062,108	11/1962	Mayo	355/14 X
3,318,213	5/1967	Kowalski	355/14
3,677,635	7/1972	Auken et al.	355/13 X
3,700,326	10/1972	Murgas et al.	355/14
3,700,327	10/1972	Murgas et al.	355/14
3,790,273	2/1974	Tanaka	355/16

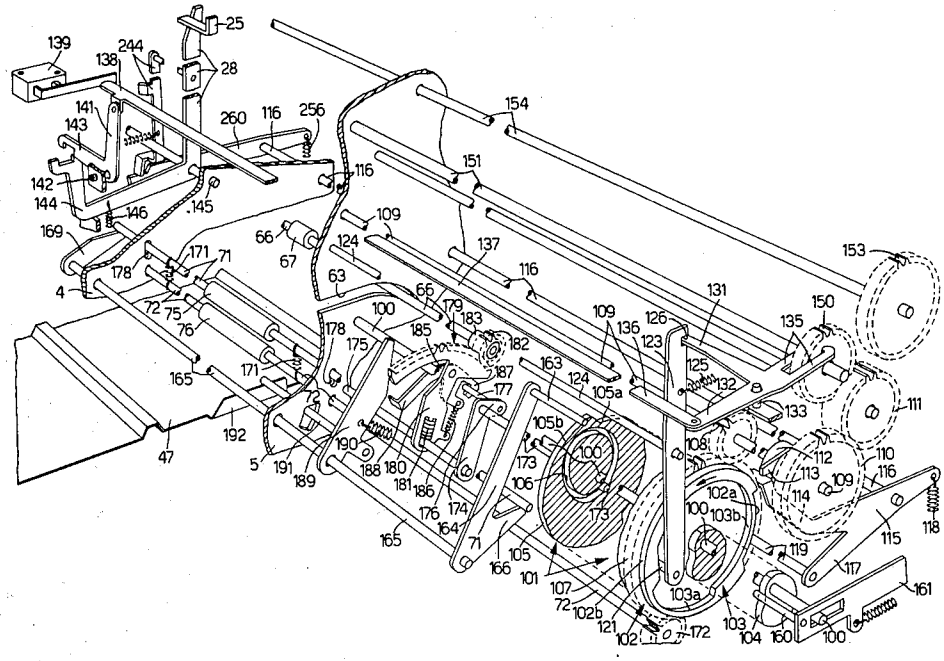
Primary Examiner—Richard L. Moses

Attorney, Agent, or Firm—I. J. Schaefer

[57] **ABSTRACT**

An electrostatic book-copier machine includes a movable carriage on which an original document is positioned for reproducing it onto a simultaneously moving length of copy paper. Cams are provided for timing the copying cycle and for synchronizing the movements of the carriage and of the copy paper with the actuation of the corona charging device and of the exposure lamp. Spring means are also provided for speeding up the return of the carriage to the home position upon completion of any copy cycle.

9 Claims, 6 Drawing Figures



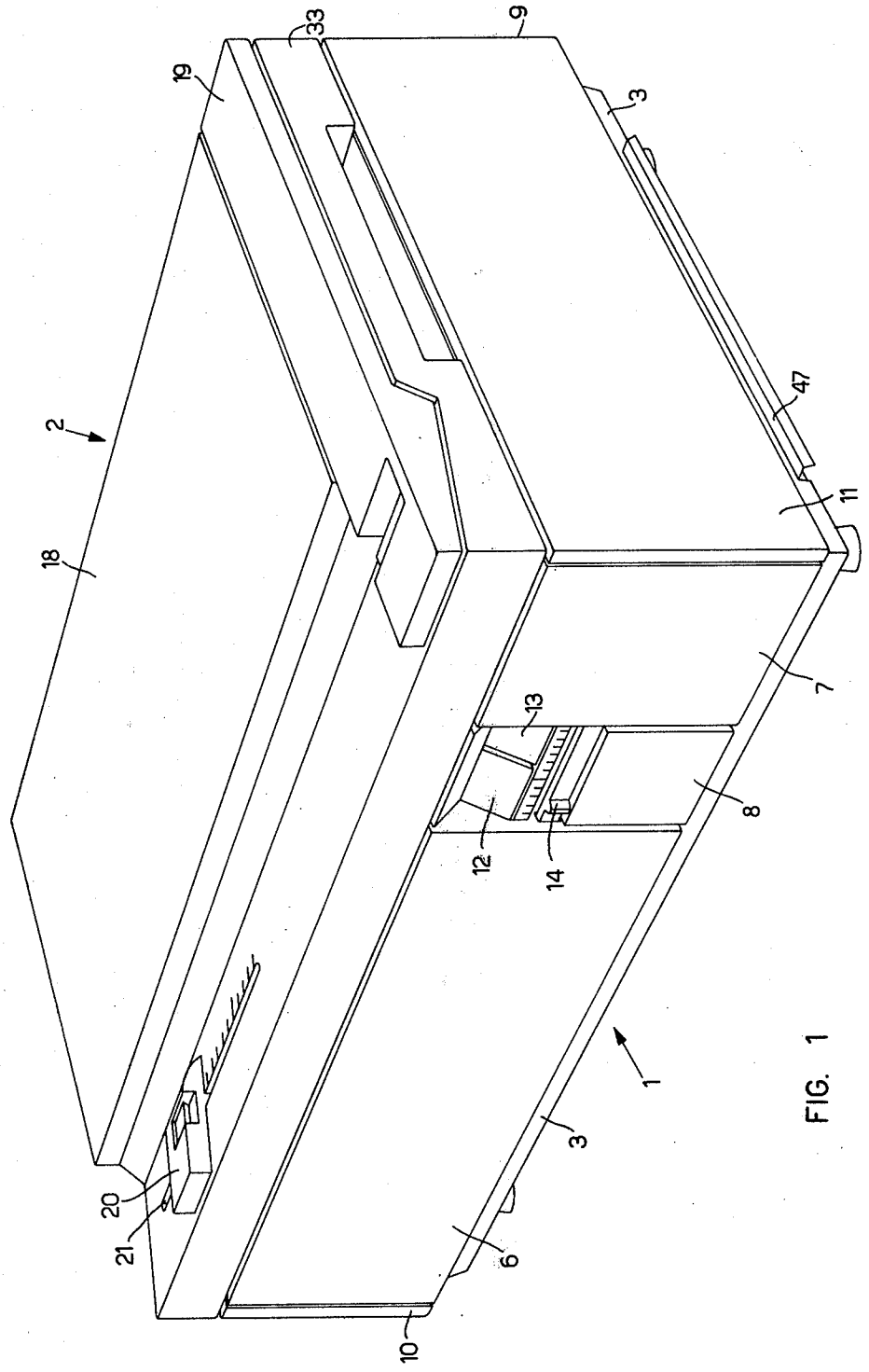


FIG. 1

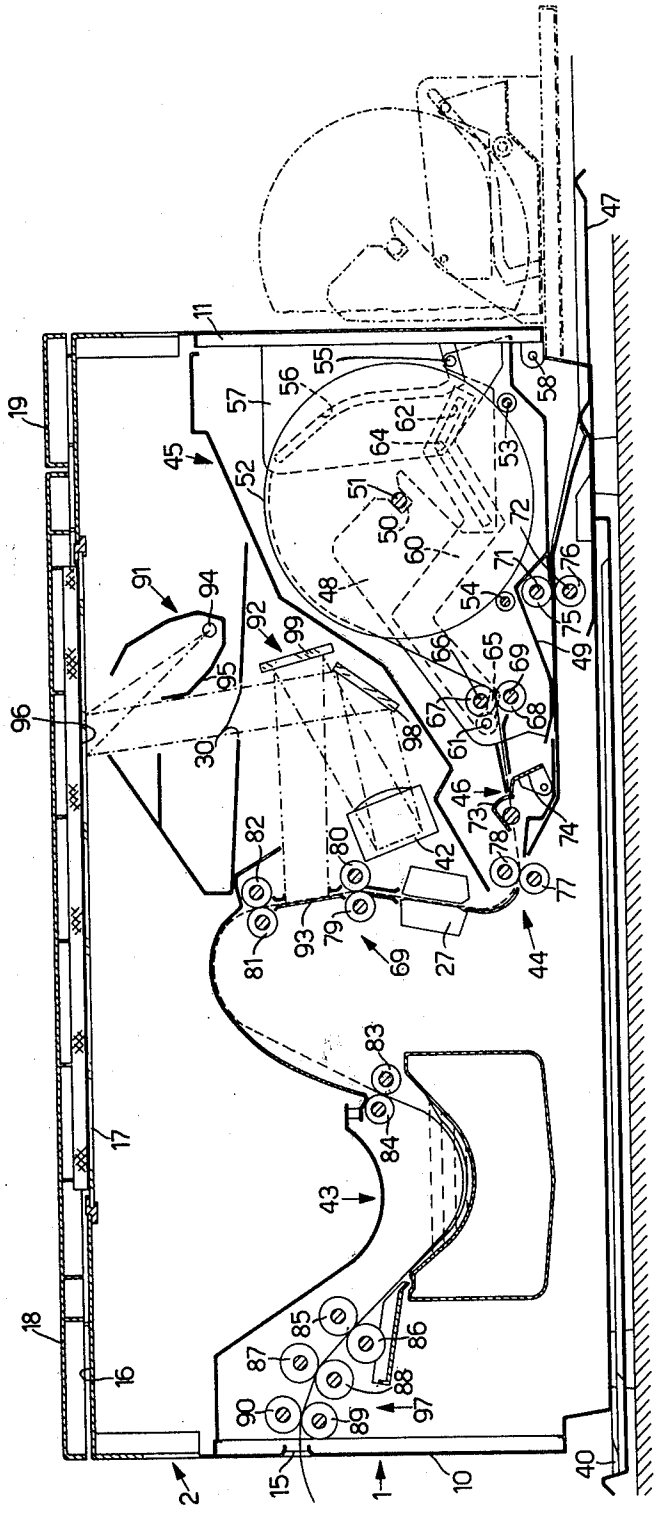

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FIG. 2

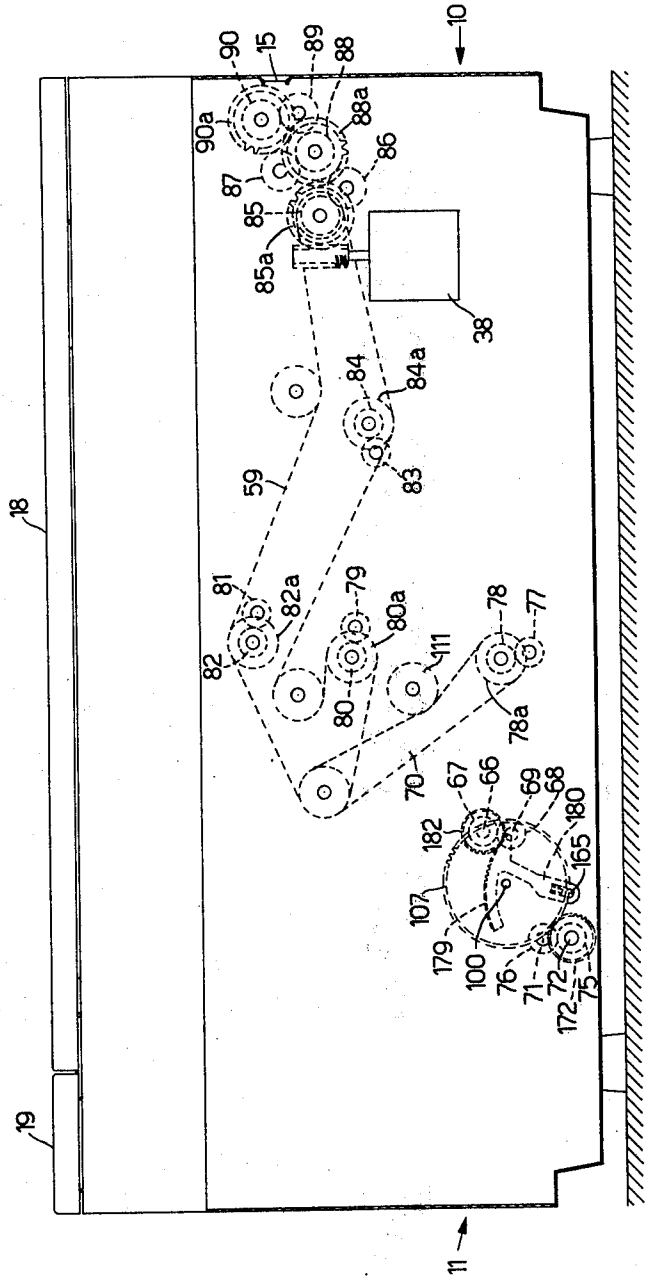
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FIG. 3

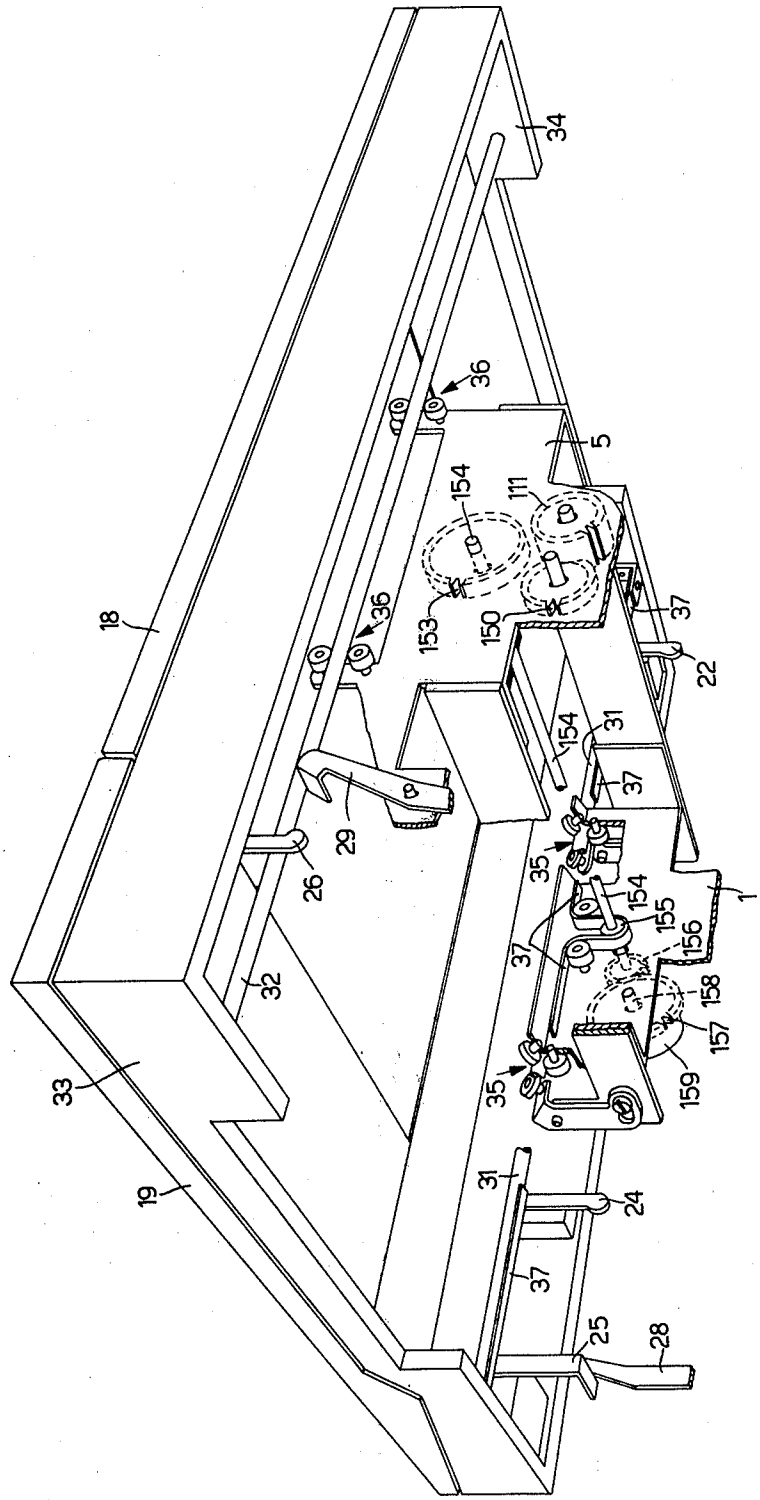
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FIG. 4

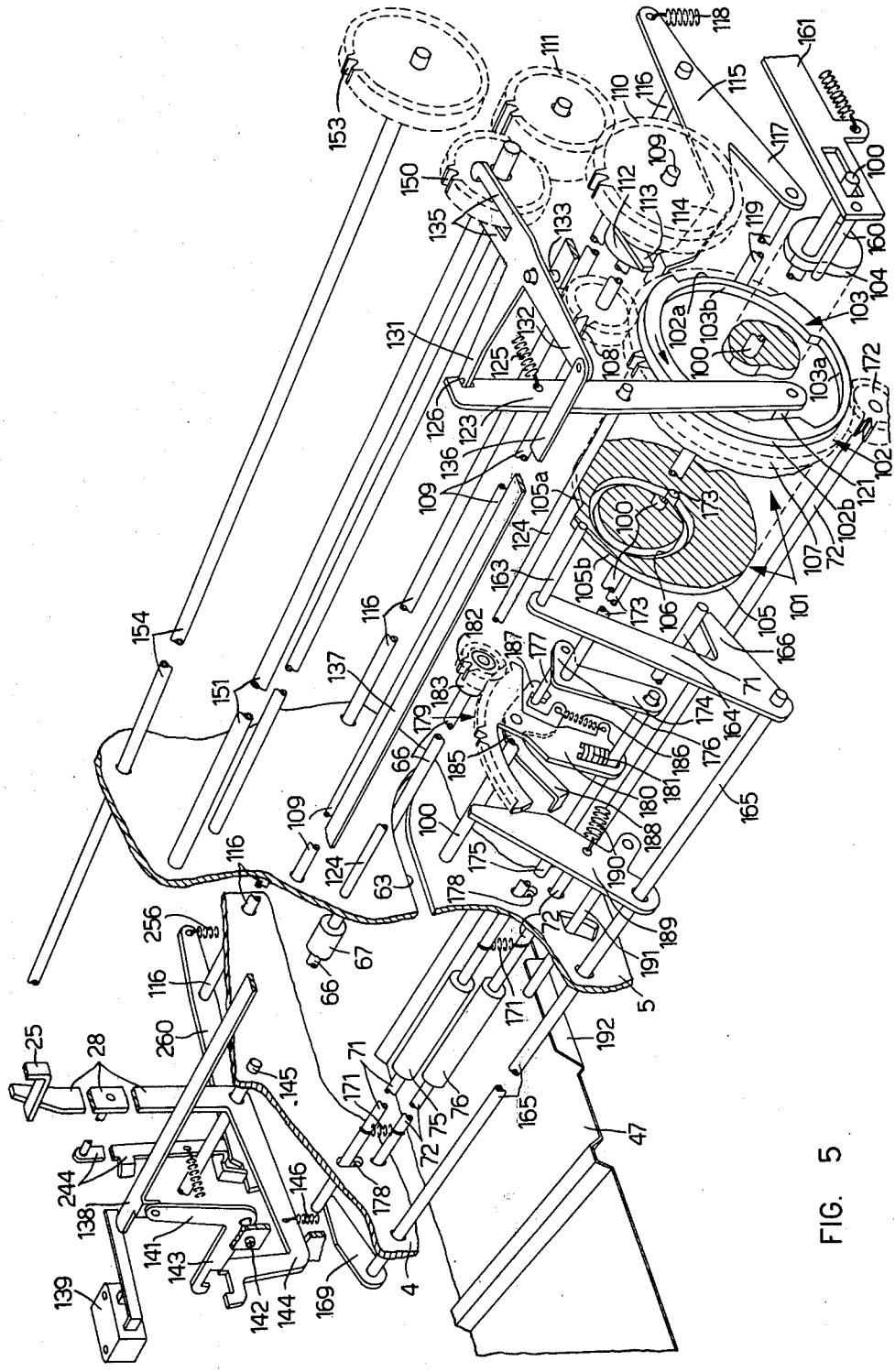

FIG. 5

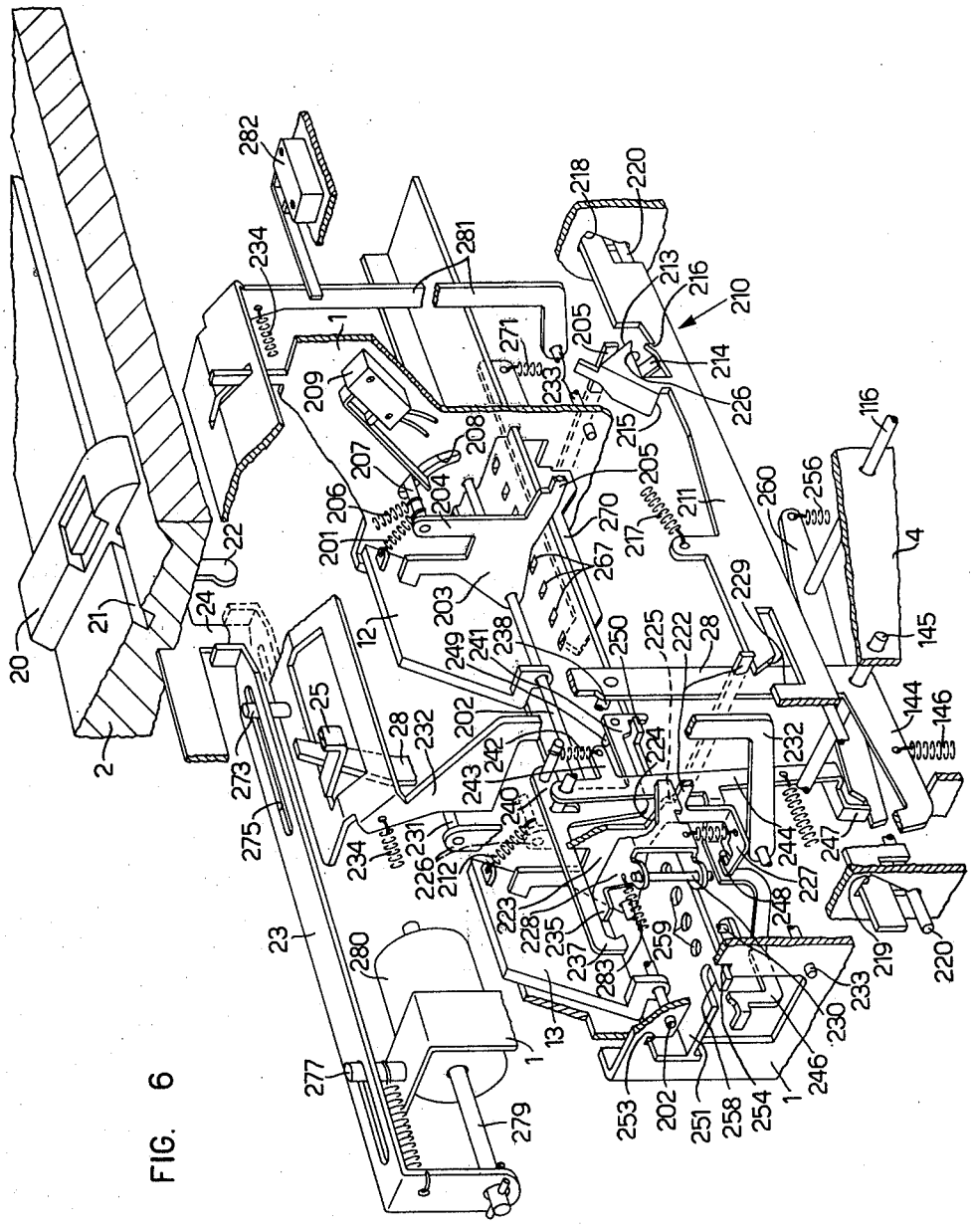

FIG. 6

ELECTROSTATIC COPYING MACHINE AND SYNCHRONIZING CONTROL SYSTEM THEREFOR

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates to electrostatic copying machines of the type in which an original is driven through a scanning zone by a first transport system while a copy sheet is synchronously driven from a feed station through a corona-effect electrostatic charging device and then through an exposure zone, at which an image of the original is formed on the copy sheet by an optical system.

In these machines, a sheet of photosensitive paper is charged electrostatically and guided to pass in the focal plane of the optical system through which the light image of the original is projected on to the sheet, forming a latent electrostatic image thereon, and the sheet is then guided to a developing station where the image is developed and fixed.

2. Description of the Prior Art

Electrostatic copying systems of the type to which the invention relates are known in which the synchronization of the various stages is obtained by using the front edge of the sheet of sensitive paper to control microswitches located in the path of the paper. With the use of thin and light sheets, control of these microswitches becomes difficult and jamming of the movement of the paper is liable to occur.

SUMMARY OF THE INVENTION

In order to overcome these disadvantages, the present invention provides an electrostatic copying machine comprising a motor, a first transport system actuated by the motor for transporting an original along a scanning zone past an illuminating system, a second transport system actuated by the motor for transporting a copy sheet fed from a feed station through a corona-effect electrostatic charging device and through an exposure zone at which an image of the original is formed by an optical system, means for synchronizing the movement of the said first and second transport system and for co-ordinating the actuation of the charging device and illuminating system with the movement of the first transport system, wherein the said means are constituted by first, second and third integral cams actuated by the motor, a clutch device controllable into a first operative position of transmission of the motion from the motor to the cams and into a second position of non-transmission of the motion from the motor to the cams, a key coupled to the clutch device for controlling the same into its first operative position and for activating the corona charging device, means actuated by the second cam for transmitting the motion from the motor to the first transport system and for activating the illuminating system, actuating means actuated by the first cam and controlling the clutch device into the second operative position, and second actuating means actuated by the third cam for feeding the copy sheet to the second transport system.

Moreover, in electrostatic copying apparatus of the type to which the invention relates and in which the first transport system comprises a carriage which performs a first travel from a first position to a second position, during which the projection of the image on to the copy sheet takes place, and a second travel from the second position to the first position, the function of which is simply to re-establish the initial conditions for the execution of a fresh copying cycle, an essential requirement for obtaining a high copying speed is that this second travel be the fastest possible, since it constitutes a dead or waiting time for the machine cycle.

The embodiment of the invention to be described below enables this requirement to be satisfied in an efficient manner.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail, by may of example, with reference to the accompanying drawings, wherein:

FIG. 1 is a front perspective view of a copying machine embodying the invention from the right;

FIG. 2 is a median longitudinal section of the copying machine; (in the present description "length" is from side to side of the machine);

FIG. 3 is a view of the rear face of the copying machine with the rear panel removed;

FIG. 4 is a rear perspective view of the carriage advance device from the right;

FIG. 5 is a rear perspective view of the synchronizing devices from the right; and

FIG. 6 is a rear perspective view of the control keys and the corresponding actuating devices from the right.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 1, the copying machine comprises a body 1 of substantially parallelepipedal form and a carriage 2 mounted slidably with respect to the body. The body 1 comprises an inner frame constituted by a base 3 and cheek plates 4 and 5 (FIG. 5), and covering panels. The cheek plate 4 is covered by front panels 6, 7, 8. The cheek plate 5 is covered by a rear panel 9. The body is moreover defined at the opposite end faces by end panels 10 and 11.

Between the panels 6 and 7 and above the panel 8 are mounted the control keys 12, 13, 14 of the machine, which will be described in detail hereinafter. The end panel 10 has a slot 15 of rectangular form (FIG. 2) constituting the exit for the copy sheet. The panels 6, 7, 8, 9, 10, 11 are all removable for allowing access to the interior of the machine.

The carriage 2 bears a plane rectangular and transparent plate 17 fast with its top surface 16 (FIG. 2), the plate constituting the illuminating surface of the machine. For positioning and covering originals on the illuminating surface 17, the carriage 2 is provided with a cover 18 (FIG. 1) hinged on one side of the carriage and operated into its open and closed positions by an arm 19 also hinged on the same side of the carriage and coupled to the cover 18 by spring means not shown in the drawing.

The carriage 2 slides from left to right and then from right to left and is equipped with a selector for the cut length of the copy sheet, formed by a slider 20 movable manually along a graduated guide 21 and carrying a projection 22 (FIG. 6) adapted to stop the carriage in a position depending on the length of the copy sheet which it is desired to obtain by means of engagement with a counter-stop 23 connected to the body 1. The sliding to the right is under the action of a spring. The sliding to the left is under the control of a driving motor and exposure takes place during this. At the end of the exposure the carriage is back in the central position.

The carriage 2 is moreover provided with projections 24, 25, 26 fast therewith (FIG. 4). The projection 24 is adapted to produce the arrest of the carriage 2 in a central position with respect to the body 1 of the machine by means of engagement with the counter-stop 23 (FIG. 6). During the movement of the carriage 2, the projections 25 and 26 are adapted to co-operate with levers 28 and 29 (FIG. 4), respectively, connected to the body 1, as will be better described hereinafter.

The carriage 2 has the function of transporting the original held in position on the illuminating surface 17 across a scanning window formed by a rectangular slot 30 (FIG. 2) located in the upper part of the body 1, where the image of the original is sent to the copy sheet by means described hereinafter. To this end, the carriage 2 is slidable on the body 1 by engagement of guide rods 31 and 32 (FIG. 4), extending longitudinally over the entire length of the carriage 2 and fixed to the end faces 33 and 34 thereof, with systems of bearing rollers 35 and 36 pivoted to the upper part of the body 1. A toothed belt 37 is fixed to the opposite ends of the carriage 2 and extends throughout the length thereof, the belt 37 permitting transmission of motion to the carriage 2 from a motor 38 (FIG. 3) through the medium of driving elements described hereinafter.

The feed of the copy sheets inside the machine takes place from a "feed" station 44 (FIG. 2) located in the section between the front panels 8 and 9 and the end panel 11 and accessible therefrom. The station 44 comprises a support 45 for the roll of photosensitive paper which can be withdrawn from the body 1 of the machine, a device 46 for cutting the copy sheet from the roll and a slide or tray 47 withdrawable from the body 1 for the supplementary feed of single sheets.

The support 45 is constituted by two side pieces 48 and a base 49 and in the side pieces there are formed two notches 50 adapted to support a spindle 51 on which is wedged a roll of sensitive paper 52. The roll rests on rollers 53 and 54 pivoted to the side pieces 48 and adapted to rotate about their own axes. A rod 55 fast with the said side pieces 48 is adapted to co-operate with slots 56 formed in side pieces 57 fast with the panel 11. The panel 11 is pivoted on the spindle 58 fixed to the body of the machine and is adapted to turn clockwise about this spindle.

A pair of levers 60 pivoted on a spindle 61 fast with the side pieces 48 have slots 62 within which a rod 64 fixed to the side pieces 57 is free to slide. The levers 60 have projections 65 adapted to co-operate with a spindle 66 pivoted in the cheek plates 4 and 5 of the machine and free to slide in slots 63 (FIG. 5) formed therein. On the spindle 66 there is keyed a first roller 67, while a second roller 68 is keyed on a spindle 69 pivoted to the side pieces 48. The rollers 67 and 68 constitute the pair of rollers for the feed, inside the machine, of the copy sheet from the roll 52. The roller 67 is a driving roller and the roller 68 is driven by the roller 67.

On the opening of the panel 11 (FIG. 2) obtained by hinging the panel downwardly, the engagement of the rod 55 with the slots 56 of the side pieces 57 produces the translation of the support 45 and, therefore, the withdrawal thereof from the inside to the outside of the machine. At the same time, owing to the engagement of the rod 64 with the slots 62 of the levers 60, the projections 65 of the levers cause the separation of the roller 67 from the roller 68. The roller 67 is withdrawn with the support 45 by sliding of the spindle 66 in the slots 63, while the roller 68 is withdrawn with the support 45 because it is pivoted to the side pieces 48 thereof.

The withdrawn position of the support is shown in broken lines in FIG. 2. The withdrawal of this support permits easier replacement of the roll 52 by the operator. The separation of the rollers 67 and 68 enables the introduction of the edge of the copy sheet, from the roll 52, into its proper path inside the machine to be facilitated after replacement of the roll has taken place.

The cutting device 46 comprises a movable blade 73 and a fixed counter-blade 74; this device is the subject of our Italian Pat. No. 928778 and will therefore not be described hereinafter, except for the working commands for the device.

The tray 47, withdrawable from the body of the machine, permits the supplementary feed of a single copy sheet of a format different from that obtainable with the roll 52 mounted on the support 45. The sheet, resting on the withdrawn tray 47, is fed to the following copy-sheet transport rollers through the medium of a pair of rollers 75 and 76 both pivoted to the cheek plates 4 and 5 of the body of the machine on spindles 71 and 72. The roller 76 is a driving roller and the roller 75 is driven.

The transport system for the copy sheet from the feed zone to the exit 15 on the opposite side of the machine, whether the sheet is fed from the roll 52 or from the tray 47 as an off-size sheet, is constituted by means of the pairs of rollers 77, 78; 79, 80; 81, 82; 83, 84; 85, 86; 87, 88; 89, 90 located above and below the path of the copy sheet, each of these rollers being keyed on a spindle rotatable in the opposite cheek plates 4, 5 of the body of the machine.

The rollers 78, 80, 82, 84, 85, 88, 90 are driving rollers and receive their motion from gears 78*a*, 80*a*, 82*a*, 84*a*, 85*a*, 88*a*, 90*a*, respectively, each coaxial with the respective roller and receiving their motion in turn from the motor 38 through endless toothed belts 59 and 70 (FIG. 3). The other rollers of each of the pairs are driven.

The following stations are distributed along the path of the copy sheet: a corona-effect charging station 27 (FIG. 2) between the pairs of rollers 77, 78; 79, 80; an exposure station 69 between the pairs of rollers 79, 80 and 81, 82; a liquid developing station 43 of known type between the pairs of rollers 83, 84 and 85, 86; and a drying station 97 constituted by the pairs of rollers 87, 88; 89, 90; 85, 86.

The exposure station 69 comprises an illuminating unit 91, an optical system 92 and an exposure window 93. The illuminating unit 91 is constituted by a lamp 94 and a reflecting optical screen 95 adapted to limit the light beam emitted by the lamp and to define an illumination zone 96 on the illuminating surface 17 borne by the carriage 2. The optical system 92 is constituted by mirrors 98 and 99 and a mirror lens 42 which are adapted to define the optical path of the light beam from the illumination zone to the exposure window 93. The light image of the part of the original passing by in front of the illumination zone 96, limited by the scanning window 30, is reflected by the mirror 98 on to the mirror lens 42 and is sent by the latter, by reflection on to the mirror 99, to the exposure window 93, where it falls on the part of the copy sheet which is passing by in front of the window.

The rollers **85, 86** of the drying station **97** for the copy sheet, which is located downstream of the developing station **43,** have a surface covering of hard rubber and form a pair of squeegee rollers. The rollers **87** and **89,** on the other hand, are covered with absorbent material, such as is described, for example, in the Applicants' Copending USP Application Ser. No. 473,115, and effect the final drying of the copy sheet, which is then delivered to the exit slot without any trace of residual developer. From the exit slot **15,** the copy sheet comes to rest in a holder for copies already made, which is constituted by a tray **40** withdrawable from beneath the body of the machine.

FIG. **5** shows the synchronizing elements for controlling the transport of the copy sheet and the movement of the carriage. On a shaft **100** pivoted in the cheek plates **4** and **5** of the body **1** there is rigidly fixed a cam system **101** constructed in a single block of rigid plastics material and comprising five cam tracks:

Track **102** for controlling the rotation of the cam system **101** itself;

Track **103** for controlling the reversal of the carriage;

Track **104** for arming the system for cutting a sheet from the roll;

Track **105** for controlling the feed of a single or separate sheet;

Track **106** for controlling the feed of the sheet from the roll.

Moreover, keyed rigidly on the shaft **100** and incorporated in the block **101** is a gear **107** for the transmission of the motion from the motor **38** to the shaft **100** and, therefore, to the cam system itself. The rotation of the cam system takes place anticlockwise with reference to FIG. **5.** The gear **107** meshes with a gear **108** keyed on a shaft **109.** A gear **110** is also keyed on the shaft **109.**

On the shaft **109,** between the gear **108** and the gear **110,** there is interposed a clutch **112,** the gear **110** being a driving gear and the gear **108** being driven through the clutch. The gear **110** receives its motion from a gear **111** actuated in turn by the motor **38** through the endless toothed belt **70,** see FIG. **3.**

The clutch **112** is controllable into the positions of release or engagement and locking or disengagement, respectively, corresponding to transmission of the motion from the gear **110** to the gear **108** and to non-transmission of the motion, by means of a lug or tongue **113.** The lug or tongue **113** co-operates with a first projection **114** of a lever **115** mounted on and fast with a spindle **116** and provided with a second projection **117** and a return spring **118.** The spindle **116** is pivoted to the frame of the machine and extends over the entire depth (front to back) thereof; a lever **260** on the opposite side of the machine (FIG. **6**) is fast with the spindle **116** and is operatively connected, by lever systems described hereinafter, to the control key **13** for the execution of a copying cycle.

A pin **119** is fast with the projection **117** and co-operates with the track **102** of the cam system **101.** The profile of this said track is composed of two circular sectors **102***a* and **102***b* complementary to 360° and belonging to two circles of different radii and having their centres on the shaft **100,** the radius of the sector **102***a* being smaller than the radius of the sector **102***b*. During the rotation of the cam system **101,** when the pin **119** engages the sector **102***a* the transmission of motion from the gear **110** to the gear **108** does not take place, since the projection **114** co-operates with the lug **113** in such manner as to hold the clutch in the locking or disengaged position, whereas there is transmission of motion when the pin **119** engages the sector **102***b*.

The cam track **103** is an internal track composed of two circular sectors **103***a* and **103***b* complementary to 360° and belonging to two circles with their centres on the shaft **100** and different radii. A pin **121** co-operates with the cam track **103** and is fast with a lever **123** pivoted on a spindle **124** fixed to the body **1** and provided with elastic return means **125.** The lever **123** is adapted to co-operate by means of a notch **126** therein with an extension **131** of a lever **132** pivoted on a pin **133** and provided with a fork **135.**

The lever **132** is articulated to one end **136** of a slidable bar **137** extending between the cheek plates **4** and **5** of the machine; at the front of the machine, the other end **138** of the bar **137** is articulated to a lever **141** pivoted on a pin **142** to the body of the machine and having a projection **143** adapted to co-operate with a projection **144** of the lever **28,** which is pivoted on a spindle **145** fixed to the body of the machine and is provided with elastic return means **146** and adapted to co-operate, as already stated, with the projection **25** fast with the carriage **2.** The end **138** of the bar **137** (FIG. **5**) is moreover adapted to actuate a microswitch **139.**

The fork **135** co-operates with a gear **150** fast with a shaft **151,** which is pivoted in the body of the machine so as to be slidable perpendicularly to the cheek plate **5.** According to the position of the lever **132,** the gear **150** is adapted to couple the gear **111** with, or uncouple it from, a gear **153** keyed on a shaft **154** pivoted in the body of the machine. Two gears **155** and **156** (FIG. **4**) are also keyed on the shaft **154.**

The gear **155** meshes with the toothed belt **37** fixed to the carriage and is adapted to transmit the motion to the carriage itself. The gear **156** meshes with a gear **157** keyed on a shaft **158** pivoted to the body of the machine. A clock spring **159** is also keyed on the shaft **158** for effecting the initial drive of the carriage to the right.

The movement of the carriage takes place from left to right with reference to FIG. **4** (back to the left in FIG. **1**) when the pin **121** engages the sector **103***a* of the cam track **103** and therefore the position of the lever **132** is such that the gear **150** receives the motion from the driving gear **111** and transmits it, through the gears **153** and **155,** to the belt **37** carrying the carriage **2** along.

The stopping and possible reversal (if more than one copy is being made) of the movement of the carriage is controlled during its motion from left to right in FIG. **4** by the striking of the projection **25** fixed to the carriage against the lever **28,** the rotation of which about the pivot **145** causes, through the medium of the lever system **141, 137** and **132** (FIG. **5**), the shifting of the gear **150** from right to left and its disengagement from the gear **153** and, therefore, the cessation of the transmission of the motion to the belt **37,** for which reason the motion is imparted to the belt by the spring **159** (FIG. **4**), — which has been wound up during the movement of the carriage from left to right —, through the gears **157** and **156** and the carriage will perform its travel in the opposite direction after an almost instantaneous stop.

A pin **160** fast with a slider **161** provided with elastic return means and coupled by a lever system, not shown in the drawing, to the movable blade **73** of the cutting

unit **46** is adapted to co-operate with the cam track **104** (FIG. **5**).

During the rotation of the cam system, the pin **160**, co-operating with the track **104**, actuates the slider **161** and produces the arming of the cutting system **46** in a manner similar to that described for the cutting device to which our Italian Pat. No. 928778 relates.

The cam track **105** is composed of two circular sectors **105***a* and **105***b* complementary to 360° which have their centres on the shaft **100** and are of different radii. A pin **163** co-operates with the track **105**. The pin **163** is fast with a pivoted lever **164** fast with a spindle **165** and having a projection **166** adapted to co-operate with the spindle **71** of the single sheet driven roller **75**. The spindle **71** is adpated to slide up and down in slotted holes **178** formed in the cheek plates **4** and **5**. A lever **169** fast and pivoting with the spindle **165** also co-operates with the spindle **71**.

When the pin **163** engages the sector **105***a* of the cam track **105**, the levers **164** and **169** are rotated clockwise with respect to the position in the drawing and the spindle **71**, no longer retained by the projection **166** and the lever **169**, is restored downwardly by elastic means **171** so that the driven roller **75** is coupled with the driving roller **76** keyed on the spindle **72** parallel to the spindle **71**. The spindle **72** receives its motion from the gear **107** by means of a gear **172**.

The cam track **106**, which is eccentric with respect to the shaft **100**, co-operates with a pin **173** fast with a lever **174** pivoted on a spindle **175** fixed to the body of the machine. The lever **174** has a projection **176** having a pin **177** fast therewith.

An element in the form of a toothed circular sector **179** having an arm **180** is pivoted, with elastic means **181** interposed, on the spindle **175** and adapted to rotate with respect thereto. The toothed sector **179** meshes with the gear **182** fixed to a unidirectional motion transmitting device **183** keyed on the spindle **66**. Transmission of the motion from the gear **182** to the spindle **66** takes place only during the anticlockwise rotation of the latter.

A lever **185** pivoted on the arm **180** and provided with elastic return means **186** has a first projection **187** adapted to co-operate with the pin **177** and a second projection **188** adapted to co-operate with a lever **189** pivoted loosely on the spindle **165** and provided with elastic return means **190**. Fast with the lever **189** is a pin **191** adapted to co-operate with a lug **192** integral with the single sheet tray **47**.

During the rotation of the cam system **101**, if the tray is in the closed position (inside the machine), the lug **192** co-operates with the pin **191** and the lever **189** is located in the position shown in FIG. **5**. Under these conditions, the projection **187** clasps the pin **177** and the motion of the cam track **106** is transmitted to the toothed sector **179** through the pin **173** and the lever **174**.

Because of the great eccentricity of the cam track **106** with respect to the shaft **100**, the movement of the toothed sector **179** is alternately clockwise and anticlockwise; during the clockwise rotation, the movement is transmitted through the gear **182** and the unidirectional motion transmitting device **183** to the spindle **66** and, therefore, to the pair of rollers **67, 68** which feed the sheet from the roll, bringing it into contact with the following transport rollers **77, 78**.

Because of the profile of the cam **106**, the rotation of the sector **179** clockwise takes place at a speed which is variable and such that the front edge of the copy sheet has, in the proximity of the transport rollers **77, 78**, a speed slightly lower than their speed of rotation, for the purpose of avoiding both any impact of the edge against the rollers and the formation of bends in the sheet. During the anticlockwise rotation of the sector **179**, on the other hand, no transmission of the movement to the rollers **67, 68** is possible because of the unidirectional transmission device **183**.

FIG. **6** shows the keys for the operative commands of the machine and their actuating devices. The manually movable key **12**, which is equipped with elastic return means **201** and pivoted on a spindle **202** fixed to the frame of the machine, is an "on" or "starting" key adapted to co-operate with a lever **203** also pivoted on the spindle **202** and provided with a first projection **204**, a second projection **205** and a return spring **206**. The projection **204** has fast with it a pin **207** engaging in a slot **208** formed in the frame of the machine. The pin **207** is adapted to control a microswitch **209**. The projection **205** is adapted to co-operate with a first slot **210** formed in a slider **211** and comprising a system of inclined surfaces **213, 214, 215**, a tooth **216** and an edge **226**.

The slider **211**, which is equipped with elastic return means **217**, is free to slide in openings **218, 219** formed in the frame of the machine and to turn within these openings about a spindle **220**. A second slot **229** formed in the slider **211** is adapted to co-operate with a first projection **222** of a lever **223** pivoted on the spindle **202** and adapted to co-operate with the manually movable key **13** also pivoted on the spindle **202** and equipped with a return spring **212**.

The projection **222** is connected to the body of the lever **223** through the medium of an element **224** having an inclined profile connected to the said projection by means of a rising portion **225**. The lever **223** is moreover provided with a second projection **226** and with a third projection **227**. The projection **222** and the element **224** are adapted to co-operate with a bail **228** provided with elastic return means **283** and pivoted on a pin **230** fixed to the frame of the machine. The second projection **226** is equipped with a pin **231** adapted to co-operate with a bail **232** pivoted on a spindle **233** fixed to the frame of the machine and furnished with return springs **234**.

The bail **228** is moreover coupled elastically to the third projection **227** of the lever **223**. A lug **235** of the bail **228** is adapted to co-operate with a lever **237** pivoted on a pin **238** fast with the lever **28** and provided with a first projection **240** and a second projection **241**. This first projection **240** is coupled by means of a spring **242** to a first projection **243** of a lever **244** pivoted on the pin **238** and having a second projection **246** and a third projection **247**.

The second projection **241** of the lever **237** is provided with a stop pin **249** and is adapted to co-operate with a tooth **250** formed on a slider **251** having the key **14** integral therewith and free to slide in guides **253**, 254 formed in the frame of the machine and constituting the setting element for the number of copies to be made.

The third projection **247** of the lever **244** is adapted to co-operate with the lever **260** provided with a return spring **256**. The second projection **246** of the lever **244**

is moreover adapted to engage in a slot **258** and in circular holes **259** formed in the slider **251** and equidistant from one another. Other holes **267**, which are square, are also formed in the slider **251** with a spacing equal to that of the holes **259**. The number of holes **267** is greater by two units than the number of holes **259**.

A lever **270** pivoted to the frame of the machine is provided with elastic return means **271** and adapted to engage in the holes **267**. The bail **232** bears a pin **273** engaging in a slot **275** formed in the counter-stop **23**. The counter-stop **23** is pivoted on a pin **277** fixed to the frame and can turn in a horizontal plane, being shifted by the pin **273** of the bail **232**. The counter-stop **23** is moreover fixed to a spindle **279** of a pneumatic damping device **280** fixed to the frame of the machine. The bail **232** is moreover adapted to actuate a microswitch **282** with its arm **281**.

By means of the microswitch **209** the key **12** controls the switching on of the electricity supply of the machine and, therefore, the activation of the driving elements thereof.

The key **13**, called the "print" key, controls the carrying out of a copying cycle. It is inoperative until such time as the on or starting key **12** has been set; in fact, in the position of FIG. **6**, in which the keys **12** and **13** are in their inoperative positions and the machine is inoperative, pressing the print key **13** has a no activating effect, inasmuch as the lever **223** connected thereto is prevented from rotating since its projection **222** bears against the slider **211**. On pressing the key **12**, on the other hand, the lever **203** connected thereto performs a clockwise rotation and its projection **205** co-operates with the inclined surface **213** of the slider **211**, causing a first travel of the slider to the left; the projection **205** is then arrested against the tooth **216**; on release of the key **12**, owing to the effect of the spring **206**, the projection **205** tends to turn anticlockwise and therefore jumps over the tooth **216** and permits the return of the slider **211** to the right through the medium of the spring **217** and, because of this, fits firmly between the edge of the inclined surface **214** and the edge **226**. Through the effect of this last travel of the slider **211** to the right, the slot **229** is brought into correspondence with the projection **222** and therefore enables the setting of the key **13**. On pressing the key **12** to switch the machine off, the projection **205**, turning clockwise, is brought below the inclined surface **214**; on release of the key **12**, owing to the effect of the spring **206**, the projection **205**, turning anticlockwise and therefore travelling over the inclined surface **214** from bottom to top, produces the clockwise rotation of the slider **211** about its pivot **220** and the engagement of the said projection with the inclined surface **215**, over which, from below, it travels upwardly, restoring the conditions shown in the drawing.

The slider **251** forming the setting element for the number of copies to be made is set manually at the desired number of copies through the key **14** (see FIG. **1**), which is integral with the slider.

In the position shown in the drawing, the slider is set for making a single copy, the slot **258** being in a position corresponding to the projection **246**.

To set the slider **251**, it it shifted to the left in FIG. **6** with a click action; to each click there corresponds the disengagement of the lever **270** from one of the square holes **267** and engagement with the hole following immediately to the right, an increase, of one unit in the number of copies set corresponding to each click. The position in which the slider is fully shifted to the left, that is when the lever **270** engages the last square hole **267** to the right, and no circular hole **259** is in correspondence with the projection **246** of the lever **244**, corresponds to the continuous making of copies.

When the machine is inoperative, it has the carriage **2** positioned centrally with respect to the body of the machine, as in FIG. **1**, and in this position the counter-stop **23** engages the projection **24** of the carriage **2** and the clock spring **159** is partially loaded. On setting the key **12**, the pin **207** actuates the microswitch **209** and, as hereinbefore stated, the motor **38** of the machine and all the auxiliary services thereof are activated. When the motor **38** is rotating, all the transport rollers for the copy sheet also rotate, with the exception of the pairs of feed rollers **75, 76** and **67, 68**. The set of cams **101** is stationary because the clutch **112** is in the locked or disengaged position.

On pressing the print key **13**, the lever **223** bearing against it turns clockwise and its projection **222** is free to engage the slot **229**. The bail **228**, no longer retained by the rising portion **225** and returned by the spring **283**, rotates anticlockwise about its pivot **230** and engages with the inclined surface **224**, thus holding the lever **223** in the rotated position and therefore ensuring the activation of the cycle even after the release of the key **13**; the rotation of the bail **228** moreover brings its lug **235** into contact with the lever **237**, which is in the position shown in the drawing if the setting element **251** is positioned for a single copy and the tooth **250** therefore co-operates with the projection **241**, and, conversely, if the setting element is positioned differently, the lever **237** is turned clockwise with respect to the position shown in the drawing and the pin **249** bears on the slider **251**.

At the same time, the pin **231** of the projection **226** of the lever **223** produces clockwise rotation of the bail **232** which, through the pin **273**, causes the clockwise rotation of the counter-stop **23** about the pivot **277** and, therefore, the disengagement of the counter-stop from the projection **24**, thereby releasing the carriage **2**, which, being returned by the spring **159**, performs a first travel to the left (with reference to FIGS. **4, 5, 6**) until the projection **22** integral with the copy length setting device or selector **20** engages the counter-stop **23**, causing the arrest of the carriage. The impact between the projection **22** and the counter-stop **23** is damped by the damping device **280**.

The carriage therefore stops in a position shifted to the left (with reference to FIGS. **5, 6**), the shifting with respect to the central position being proportional to the length of the sheet format set by means of the slider **20**. This shift to the left is a shift to the right as viewed from the front of the machine, as in FIG. **1**.

The rotation of the bail **232** moreover produces the actuation of the microswitch **282**, which conveys the current to the charging device **27**.

At the same time, the rotation of the lever **223** causes the engagement of its projection **227** with the projection **246** of the lever **244**, which performs an anticlockwise rotation producing the rotation of the lever **260** and, therefore, of the spindle **116** anticlockwise. The projection **227** then remains in the rotated position until the key **13** is released, allowing the projection **246** freedom of movement owing to the slot **248** with which the projection **227** is provided.

The rotation of the spindle **116** causes the rotation of the lever **115** anticlockwise and, therefore, the release or engagement of the clutch **112** and the transmission of motion to the cam system **101**; as already described, the clutch remains engaged for that part of the rotation of the cam track **102** during which the pin **119** engages the sector **102***b*. Simultaneously with the commencement of rotation of the cams **101** there is obtained the commencement of the feed of the copy sheet from the roll or from the tray through the medium of the pairs of rollers **67, 68** and **75, 76,** respectively, according to whether the tray is not or is withdrawn.

The cam track **103** is designed and phased in such manner that the engagement of the pin **121** of the lever **123** with the cam track **103***a* takes place when the front edge of the copy sheet fed from inside the machine and transported along its path by the pair of rollers **77, 78** arrives at a point a few millimetres from the exposure window **93.**

The rotation of the cam system then continuing, when the pin **121** engages the cam track **103***a*, there is obtained, as already described, the transmission of the motion to the belt **37** of the carriage **2** and, owing to the movement of the rod **137,** the lighting of the illuminating lamp **94** through the medium of the microswitch **139.** The carriage **2** consequently performs a travel from left to right (with reference to FIGS. **4, 5, 6**) at a speed equal to the speed of transport of the copy sheet across the exposure window, where the sheet receives the image of the original transported by the carriage.

During this travel, the engagement of the projection **26** of the carriage with the lever **29** commands the carrying out of the cutting of the copy sheet from the roll, the cutting device being armed during the rotation of the cam track **104.** During the said travel, the rotation of the cam system for one revolution is completed and the system is stopped when the pin **119** engages the sector **102***a* again.

The travel from left to right (back to the left in FIG. **1**) comes to an end when the projection **25** engages the lever **28,** causing the clockwise rotation thereof, the extinction of the illuminating lamp **94** and, as already seen, the disengagement of the gear **150** from the gear **153,** which produces the almost instantaneous stopping of the carriage and the reversal of its movement.

As it rotates, the lever **28,** through the pin **238,** rotates the lever **244,** which lever strikes the spindle **145** and fulcrums thereon, rotating clockwise until its projection **246** engages in a hole **259** or with the surface of the slider **251** if the latter is set at a number of copies greater than one or for continuous copying, respectively.

The rotation of the lever **28** continuing, the lever **244** is prevented from continuing the aforesaid rotation by the engagement of the projection **246** with the slider **251** and, therefore, the lever **244,** carried along by the lever **28,** carries out a movement to the right and downwardly, causing the movement of the setting element **251** to the right by one step, if the projection **246** has been in engagement with a hole **259,** and the anticlockwise rotation of the lever **260,** which, releasing or engaging the clutch **112,** initiates a fresh copying cycle. The levers then return to rest, restored by the respective return spring. The carriage meanwhile finishes its travel from right to left (in FIGS. **4** and **5**) returned by the spring **159,** when the projection **22** strikes the counter-stop **23** held in the rotated position by the engagement of the pin **231** with the bail **232.**

If, on the other hand, the slider **251** has the slot **258** in correspondence with the projection **246,** then the clockwise rotation of the lever **244** and of its projection **246** about the fulcrum **145** continues and there is therefore no engagement of the lever **244** with the lever **260** and, therefore, the clutch is not engaged again and the lever **28** carries along in its rotation to the right the lever **237,** which is positioned with the projection **241** in contact with the tooth **250** and therefore causes the bail **228** to rotate clockwise; the bail disengages itself from the inclined surface **224** of the lever **223** and permits its rotation anticlockwise and, therefore, the raising of the key **13,** the anticlockwise rotation of the bail **232** and the positioning of the counter-stop **23** in the path of the projection **24,** and in general the restoration of the conditions shown in FIG. **6,** so that the carriage will position itself centrally with respect to the body **1** during its spring-produced return travel.

What we claim is:

1. An electrostatic copying machine of the type having a motor, a first transport system actuated by the motor for transporting an original along a scanning zone past an illuminating system, a second transport system actuated by the motor for transporting a copy sheet fed from a feed station through a corona-effect electrostatic charging device and through an exposure zone at which an image of the original is formed by an optical system, means for synchronizing the movement of the said first and second transport systems and for co-ordinating the actuation of the charging device and illuminating system with the movement of the first transport system, said means comprising in combination:

a first cam actuated by the motor,

a second cam integral with said first cam and movable therewith,

a third can integral with said second cam and movable therewith,

a clutch device movable into a first operative position of transmission of the motion from the motor to said first cam and into a second position of non-transmission of the motion from the motor to said first cam,

a key for effecting the movement of said clutch device into its first operative position and for switching on the corona changing device,

means actuated by said first cam for transmitting the motion from the motor to the first transport system and for activating the illuminating system,

means actuated by said second cam for feeding the copy sheet to the second transport system; and

means actuated by said third cam for causing said clutch device to move into its second position.

2. A copying machine according to claim **1,** wherein the first transport system receives its motion from the motor through a plurality of gears, a movable one of which is movable between an operative position and a position of disengagement from the rest of said plurality, said means actuated by said first cam comprising a lever system controlling the passage of said movable gear between the said position of disengagement and the said operative position.

3. A copying machine according to claim **2,** wherein the first transport system comprises a carriage movable on the body of the machine in sequence between an in-

operative position, a first working position and a second working position, the inoperative position being intermediate between the first and second working positions, the movement of the carriage during the execution of a copying cycle being constituted by a first travel between the inoperative position and the first working position, a second travel from the first working position to the said second working position, during which the light image of the original transported along the scanning zone is formed on the copy sheet which is simultaneously moved through the exposure zone, and a third travel from the second working position to the inoperative position, said movable gear being in the operative position during the second travel and in the position of disengagement during the first and third travels.

4. A copying machine according to claim **3,** further comprising:

a first element fast with the carriage which cooperates with a first stop connected to the body of the machine when the carriage is stationary in the inoperative position,

a spring partially loaded when the carriage is in its inoperative position which imparts the movement to the carriage during the first and third travels; and

means for loading said spring during said second travel.

5. A copying machine according to claim **4,** further comprising:

a second element borne by the carriage and cooperating during the second travel with said lever system for shifting said movable gear from said operative position to said position of disengagement, to produce the execution of the third travel and for switching off the illuminating system.

6. A copying machine according to claim **5,** wherein the feed station comprises means for feeding copy sheets from a roll, and further comprising:

a selector for the length to which the copy sheet is to be cut from the roll borne by the carriage and including a third element movable therewith,

a second stop connected to the body of the machine and co-operating with said third element for defining said first working position, to vary the length of the said first travel proportionally with the variation in the length of the copy sheet set by means of the selector.

7. A copying machine according to claim **6,** further comprising:

an actuatable device for cutting the copy sheet from the roll during the said second travel, and

a fourth element carried by the carriage and fixed thereto for actuating said device during said second travel.

8. A copying machine according to claim **5,** wherein the feed station comprises means for feeding copy sheets from a roll, further comprising:

a supplementary feed station for an off-size copy sheet including a tray withdrawable from the body of the machine,

activatable means for feeding the off-size copy sheet placed in said tray in the withdrawn position,

a fourth cam integral with said first, second and third cams for activating said activatable means for feeding, and

means for disenabling the actuation of the third cam upon the withdrawal of the tray.

9. A copying machine according to claim **4,** wherein a setting element for the number of copies to be made which is present in the machine and is positionable for the execution of a single copying cycle or a predetermined number of copying cycles or for the continuous execution of copying cycles and further comprising:

a lever system for the removal of the first stop connected to the body of the machine from the path of the first element fast with the carriage for each position of the setting element different from that for the execution of a single copying cycle, the said third and first travels constituting for each position of the setting element different from that for the execution of a single copying cycle a single travel from the second working position to the first working position.

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UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

PATENT NO. : 3,900,256

DATED : August 19, 1975

INVENTOR(S) : Giovanni Ravera, Giorgio Siletto and Carlo Bellis

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

On the first page after

" [73] Assignee" delete "Ing. C. Olivette & C., S.p.A., Turin, Italy" and insert -- Ing. C. Olivetti & C., S.p.A., Ivrea, Italy--.

Signed and Sealed this

ninth Day of *December 1975*

[SEAL]

Attest:

RUTH C. MASON
Attesting Officer

C. MARSHALL DANN
Commissioner of Patents and Trademarks